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EXAMINER	
TORRES, JOSEPH D	
ART UNIT	**PAPER NUMBER**
2133	

DATE MAILED: 04/05/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/882,283	CHEN ET AL.	
	Examiner	Art Unit	
	Joseph D. Torres	2133	

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address* --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *09 March 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *2-32* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *2-32* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *14 June 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

/1D

DETAILED ACTION

Response to Arguments

1. Applicant's arguments with respect to claims 2-32 have been considered but are moot in view of the new ground(s) of rejection.

Claim Rejections - 35 USC § 112

2. Claims 2-32 rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 2, 15 and 29-32 recite, "processing a forward recursion on said input soft decision information based on said reduced-state trellis representation to produce forward state metrics". The Examiner asserts that "input soft decision information" does not have a graph structure that can be traversed using forward recursions. In addition, a forward recursion is generally an abstract transition on a trellis used to design the process by which forward recursion metrics, i.e., "forward state metrics", are calculated. It is not clear how the recursion itself can be processed. Furthermore "based on" is indefinite and the relationship between "input soft decision information" and "forward state metrics" is indefinite.

The Examiner suggest the following language: --performing forward recursion calculations on said reduced-state trellis representation using said input soft decision information to produce forward state metrics--.

Claims 2, 15 and 29-32 recite, “processing a backward recursion on said input soft decision information based on said reduced-state trellis representation to produce backward state metrics”. The Examiner asserts that “input soft decision information” does not have a graph structure that can be traversed using backward recursions. In addition, a backward recursion is generally an abstract transition on a trellis used to design the process by which backward recursion metrics, i.e., “backward state metrics”, are calculated. It is not clear how the recursion itself can be processed. Furthermore “based on” is indefinite and the relationship between “input soft decision information” and “backward state metrics” is indefinite.

The Examiner suggest the following language: --performing backward recursion calculations on said reduced-state trellis representation using said input soft decision information to produce backward state metrics--.

Claims 2-32 are rejected under 35 U.S.C. 112, second paragraph, as being incomplete for omitting essential structural cooperative relationships of elements, such omission amounting to a gap between the necessary structural connections. See MPEP § 2172.01. The preambles in claims 2-32 are substantially recite digital information systems and devices for updating soft decision information into higher confidence information. The omitted structural cooperative relationships are: any relationship between “digital information” and “higher confidence information”.

Claim Rejections - 35 USC § 101

35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

3. Claims 2-30 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter. The body of the claims 2-30 are directed to an abstract algorithm performed on the basis of an abstract FSM model intended for use in a processing system. A processing system can be carried out by hand or by computer software. An abstract algorithm performed on the basis of an abstract is non-statutory subject matter. There is no connection to the body of the claims and any tangible hardware.

Claims 2-32 rejected under 35 U.S.C. 101 because the claimed invention lacks patentable utility. Since there is no relationship between "digital information" recited in the preambles of claims 2, 15 & 29-32 and "higher confidence information", it is not clear how any of claims 2-32 perform any useful process and as written are an abstract process or algorithm for generating an abstract "higher confidence information" data structure.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

4. Claims 2, 4-15, 17-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cheng; Jung-Fu (US 6658071 B1) in view of Ross; John Anderson Fergus et al. (US 6128765 A, hereafter referred to as Ross).

35 U.S.C. 103(a) rejection of claims 2, 15, 29 and 30.

Cheng teaches a digital information processing system wherein a model of a finite state machine FSM receiving a plurality of FSM inputs (the Abstract and col. 4, lines 65-67 in Cheng teach that Convolutional decoder 52 in Figure 5 of Cheng for receiving a plurality of received convolutionally coded inputs is based on a Delayed-Decision-Feedback Log-MAP algorithm, which generalizes the traditional BCJR paradigm to a reduced state trellis; Note: a convolutional encoder is a FSM, hence convolutionally coded inputs are FSM inputs and circuitry for producing decoded data by producing forward and Backward metrics for a reduced state trellis as the reduced state trellis is traversed in the forward and backward directions is substantially a model of an FSM) and producing

a plurality of FSM outputs is represented by a reduced-state trellis (Convolutional decoder 52 in Figure 5 of Cheng which is based on a generalized BCJR paradigm for a reduced state trellis produces a plurality of FSM outputs represented by a reduced-state trellis) and wherein said FSM inputs are defined on a base closed set of symbols (the symbols d_k in Figure 5 are derive from a finite field and any finite field is a closed set), a method for updating soft decision information on said FSM inputs into higher confidence information, the method comprising: inputting said soft decision information in a first index set (col. 9, lines 9-11 in Cheng teach that $V(C_m)$ is a priori log-likelihood soft decision information input for Convolutional decoder 52 in Figure 5 of Cheng; Note: $V(C_m)$ is an indexed set and is soft input for Convolutional decoder 52); processing a forward recursion on said input soft decision information based on said reduced-state trellis representation to produce forward state metrics and forward transition metrics (Steps 66-72 in Figure 6 of Cheng are steps for processing a forward recursion on said input soft decision information based on said reduced-state trellis representation to produce forward state metrics; branch metrics in col.8, lines 55-65 in Cheng are used for calculating forward state metrics, hence are forward transition metrics); processing a backward recursion on said input soft decision information based on said reduced-state trellis representation to produce backward state metrics and backward transition metrics, wherein said backward recursion is independent of said forward recursion (Steps 74-80 in Figure 6 of Cheng are steps for processing a backward recursion on said input soft decision information based on said reduced-state trellis representation to produce backward state metrics; branch metrics in col.8, lines 55-65 in Cheng are used

for calculating backward state metrics, hence are backward transition metrics; Note: Steps 66-72 and Steps 74-80 in Figure 6 of Cheng are performed independently of each other, hence backward recursion is independent of said forward recursion); operating on said forward state metrics, forward transition metrics, backward transition metrics and said backward state metrics to produce said higher confidence information (Step 78 in Figure 6 of Cheng produces higher confidence extrinsic information, $w(c_{nb})$ in equation 41 in col. 13); and outputting said higher confidence information (Steps 74-80 in Figure 6 of Cheng teach that when iteration are completed, the final higher confidence extrinsic information $w(c_{nb})$ is the final output for the generalized BCJR algorithm for reduced state trellises, hence Steps 66-80 in Figure 6 of Cheng are steps for operating on said forward state metrics, forward transition metrics, backward transition metrics and said backward state metrics to produce said higher confidence information).

However Cheng does not explicitly teach the specific use of a process whereby backward and forward recursions are performed substantially independently of each other without requiring information on decisions made during the recursions.

Ross, in an analogous art, teaches use of a process whereby backward and forward recursions are performed substantially independently of each other without requiring information on decisions made during the recursions (see Abstract and Equations 9 and 10 in col. 3 of Cheng).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Cheng with the teachings of Ross by including an additional step of use of a process whereby backward and forward recursions are

performed substantially independently of each other without requiring information on decisions made during the recursions. This modification would have been obvious to one of ordinary skill in the art, at the time the invention was made, because one of ordinary skill in the art would have recognized that use of a process whereby backward and forward recursions are performed substantially independently of each other without requiring information on decisions made during the recursions would have provided the opportunity to reduce decoding latency and required memory (see Abstract and in Cheng).

35 U.S.C. 103(a) rejection of claims 4 and 17.

Equations 25 and 26 in col. 10 of Cheng teach said operating comprises at least one of the following operations: summing, multiplication, minimum, maximum, minimum*, maximum*, linear weighting and exponentiation.

35 U.S.C. 103(a) rejection of claims 5 and 18.

γ_n in equations 6 and 7 in col. 7 of Cheng is "residual state information". Equation 9 in col. 7 of Cheng teaches using residual state information to augment reduced-state trellis information to produce said forward state metrics. Steps 66-72 in Figure 6 of Cheng teach that "residual state information" is updated on each iteration since γ_n in equations 6 and 7 in col. 7 of Cheng varies as the trellis is traversed during the calculation of forward metrics.

35 U.S.C. 103(a) rejection of claims 6 and 19.

γ_n in equations 6 and 7 in col. 7 of Cheng is "residual state information". Equation 9 in col. 7 of Cheng teaches using residual state information to augment reduced-state trellis information to produce said backward state metrics. Steps 74-80 in Figure 6 of Cheng teach that "residual state information" is updated on each iteration since γ_n in equations 6 and 7 in col. 7 of Cheng varies as the trellis is traversed during the calculation of backward metrics.

35 U.S.C. 103(a) rejection of claims 7, 8, 20 and 21.

The variables S_n equations 6 and 7 in col. 7 of Cheng correspond to states of an FSM, hence "residual state information" γ_n is a plurality of decisions on said FSM inputs.

35 U.S.C. 103(a) rejection of claims 9, 10, 22 and 23.

The variables S_n equations 6 and 7 in col. 7 of Cheng correspond to states of a symbol at time = i and j, hence the closed set of symbols used in the calculation of the "residual state information" γ_n is revised each time the "residual state information" γ_n is updated. Note: i and j determine the partition of symbols used in the calculation.

35 U.S.C. 103(a) rejection of claims 11, 24 and 28.

Col. 10, lines 50-58, Cheng suggest the use of the Log-MAP module taught in Cheng for use in an Iterative SISO decoder for Turbo codes.

35 U.S.C. 103(a) rejection of claims 12 and 25.

A convolutional code is substantially a model for partial response channels in a communication medium or a storage medium, hence said finite state machine is operative to model at least one of the following: a communication medium; a storage medium; and an imaging medium.

35 U.S.C. 103(a) rejection of claims 13 and 26.

A trellis is a model of a convolutional encoder which is a forward error correction encoder.

35 U.S.C. 103(a) rejection of claims 14 and 27.

See U_n in Figure 5 of Cheng. U_n is composed of desired signal x_n and a multi-path fading interference signal.

1. Claims 3 and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cheng; Jung-Fu (US 6658071 B1) and Ross; John Anderson Fergus et al. (US 6128765 A, hereafter referred to as Ross) in view of Crozier; Stewart et al. (US 6145114 A, hereafter referred to as).

35 U.S.C. 103(a) rejection of claims 3 and 16.

Cheng and Ross substantially teaches the claimed invention described in claim 2 (as rejected above).

However Cheng and Ross does not explicitly teach the specific use of iterative SISO decoding using the Log-MAP algorithm.

Crozier, in an analogous art, teaches iterative SISO decoding using the Log-MAP algorithm (see Fig. 1 in Crozier; Note: log-APP is used synonymously with Log-MAP). The Examiner asserts that Cheng substantially teaches the inner operation of the Log-MAP algorithm, which generalizes the traditional BCJR paradigm to a reduced state trellis (Abstract and col. 4, lines 65-67 in Cheng) and clearly suggest its use in an Iterative SISO decoders for Turbo codes (col. 10, lines 50-58, Cheng), however does not teach the operation of the iterative SISO decoder. Crozier on the other hand teaches and iterative SISO decoder (See Figure 1 in Crozier). In addition, Crozier teaches that feedback is used to modify input soft decision information L using said output higher confidence information L_{out}. Note: iterations are continued until a final decision is made. Hence one of ordinary skill in the art at the time the invention was made would have been highly motivated by the suggestion in the Cheng patent to modify the teachings in the Cheng patent by including it in an iterative SISO decoder in order to implement a SISO decoder.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Cheng and Ross with the teachings of Crozier by including use of iterative SISO decoding using the Log-MAP algorithm, which generalizes the traditional BCJR paradigm to a reduced state trellis as taught in the Cheng patent. This modification would have been obvious to one of ordinary skill in the art, at the time the invention was made, because one of ordinary skill in the art would

have recognized that use of iterative SISO decoding using the Log-MAP algorithm, which generalizes the traditional BCJR paradigm to a reduced state trellis as taught in the Cheng patent would have provided the opportunity to implement a SISO decoder suggested by Cheng (col. 10, lines 50-58, Cheng).

2. Claims 31 and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cheng; Jung-Fu (US 6658071 B1) and Ross; John Anderson Fergus et al. (US 6128765 A, hereafter referred to as Ross) in view of Benedetto et al. (S. Benedetto, G. Montorsi, D. Divsalar and F. Pollara in "Soft-Output Decoding Algorithms in Iterative Decoding of Turbo Codes," The Telecommuinications and Data Acquisition Progress Report, Jet Propulsion Laboratory, California Institute of Technology, vol. 42-124, pp. 63-87, February 1996) in view further of Ross; John Anderson Fergus et al. (US 6128765 A, hereafter referred to as Ross)

35 U.S.C. 103(a) rejection of claims 31 and 32.

In a digital information processing system wherein a model of a finite state machine FSM receiving a plurality of FSM inputs (the Abstract and col. 4, lines 65-67 in Cheng teach that Convolutional decoder 52 in Figure 5 of Cheng for receiving a plurality of received convolutionally coded inputs is based on a Delayed-Decision-Feedback Log-MAP algorithm, which generalizes the traditional BCJR paradigm to a reduced state trellis; Note: a convolutional encoder is a FSM, hence convolutionally coded inputs are FSM inputs and circuitry for producing decoded data by producing forward and

Backward metrics for a reduced state trellis as the reduced state trellis is traversed in the forward and backward directions is substantially a model of an FSM) and producing a plurality of FSM outputs is represented by a reduced-state trellis (Convolutional decoder 52 in Figure 5 of Cheng which is based on a generalized BCJR paradigm for a reduced state trellis produces a plurality of FSM outputs represented by a reduced-state trellis) and wherein said FSM inputs are defined on a base closed set of symbols (the symbols d_k in Figure 5 are derive from a finite field and any finite field is a closed set), a method for updating soft decision information on said FSM inputs into higher confidence information, the method comprising: inputting said soft decision information in a first index set (col. 9, lines 9-11 in Cheng teach that $V(C_m)$ is a priori log-likelihood soft decision information input for Convolutional decoder 52 in Figure 5 of Cheng; Note: $V(C_m)$ is an indexed set and is soft input for Convolutional decoder 52); processing a forward recursion on said input soft decision information based on said reduced-state trellis representation to produce forward state metrics and forward transition metrics (Steps 66-72 in Figure 6 of Cheng are steps for processing a forward recursion on said input soft decision information based on said reduced-state trellis representation to produce forward state metrics; branch metrics in col.8, lines 55-65 in Cheng are used for calculating forward state metrics, hence are forward transition metrics); processing a backward recursion on said input soft decision information based on said reduced-state trellis representation to produce backward state metrics and backward transition metrics, wherein said backward recursion is independent of said forward recursion (Steps 74-80 in Figure 6 of Cheng are steps for processing a backward recursion on

said input soft decision information based on said reduced-state trellis representation to produce backward state metrics; branch metrics in col.8, lines 55-65 in Cheng are used for calculating backward state metrics, hence are backward transition metrics; Note: Steps 66-72 and Steps 74-80 in Figure 6 of Cheng are performed independently of each other, hence backward recursion is independent of said forward recursion); operating on said forward state metrics, forward transition metrics, backward transition metrics and said backward state metrics to produce said higher confidence information (Step 78 in Figure 6 of Cheng produces higher confidence extrinsic information, $w(c_{nb})$ in equation 41 in col. 13); and outputting said higher confidence information (Steps 74-80 in Figure 6 of Cheng teach that when iteration are completed, the final higher confidence extrinsic information $w(c_{nb})$ is the final output for the generalized BCJR algorithm for reduced state trellises, hence Steps 66-80 in Figure 6 of Cheng are steps for operating on said forward state metrics, forward transition metrics, backward transition metrics and said backward state metrics to produce said higher confidence information).

However Cheng does not explicitly teach the specific use of specific hardware for implementing the device taught in the Cheng patent.

Benedetto et al. (hereafter referred to as Benedetto), in an analogous art, teaches a plurality of device inputs for inputting said soft decision information in a first index set (Figure 6 in Benedetto provides a plurality of device inputs for inputting said soft decision information in a first index set); a plurality of processing units for processing a forward recursion on said input soft decision information based on said reduced-state trellis representation to produce forward state metrics and forward state transition

metrics, processing a backward recursion on said input soft decision information based on said reduced-state trellis representation to produce backward state metrics and backward state transition metrics, wherein said backward recursion is independent of said forward recursion, and operating on said forward state metrics, said forward state transition metrics, said backward state metrics and said backward state transition metrics to produce said higher confidence information (Figure 6 in Benedetto provides a plurality of a plurality of processing units for processing a forward recursion on said input soft decision information based on said reduced-state trellis representation to produce forward state metrics and forward state transition metrics, processing a backward recursion on said input soft decision information based on said reduced-state trellis representation to produce backward state metrics and backward state transition metrics, wherein said backward recursion is independent of said forward recursion, and operating on said forward state metrics, said forward state transition metrics, said backward state metrics and said backward state transition metrics to produce said higher confidence information); and a plurality of device outputs for outputting said higher confidence information (Figure 6 in Benedetto provides a plurality of device outputs for outputting said higher confidence information). The Examiner asserts that Cheng substantially teaches the inner operation of the Log-MAP algorithm, which generalizes the traditional BCJR paradigm to a reduced state trellis (Abstract and col. 4, lines 65-67 in Cheng) and explicitly suggests its use in the Iterative SISO decoders for Turbo codes taught in Benedetto (col. 10, lines 50-58, Cheng).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Cheng with the teachings of Benedetto by including use of specific hardware for implementing the device taught in the Cheng patent. This modification would have been obvious to one of ordinary skill in the art, at the time the invention was made, because one of ordinary skill in the art would have recognized that use of specific hardware for implementing the device taught in the Cheng patent would have provided the opportunity to implement the suggested decoder in Chang according to Chang's suggesting that it be implemented in the SISO decoders of Benedetto (col. 10, lines 50-58, Cheng).

However Cheng and Benedetto does not explicitly teach the specific use of a process whereby backward and forward recursions are performed substantially independently of each other without requiring information on decisions made during the recursions.

Ross, in an analogous art, teaches use of a process whereby backward and forward recursions are performed substantially independently of each other without requiring information on decisions made during the recursions (see Abstract and Equations 9 and 10 in col. 3 of Cheng).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Cheng and Benedetto with the teachings of Ross by including an additional step of use of a process whereby backward and forward recursions are performed substantially independently of each other without requiring information on decisions made during the recursions. This modification would have been obvious to one of ordinary skill in the art, at the time the invention was made,

because one of ordinary skill in the art would have recognized that use of a process whereby backward and forward recursions are performed substantially independently of each other without requiring information on decisions made during the recursions would have provided the opportunity to reduce decoding latency and required memory (see Abstract and in Cheng).

Conclusion

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Joseph D. Torres whose telephone number is (571) 272-3829. The examiner can normally be reached on M-F 8-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Albert Decady can be reached on (571) 272-3819. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Joseph D. Torres, PhD
Primary Examiner
Art Unit 2133